Space Weather Technical Forecast

Issued on Saturday, 16 April 2022 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of further G1/Minor geomagnetic storms on days 1 to 3 (16th-18th) due to coronal hole high speed stream affects. Chance of further R1 radio blackouts from M class flares. Increasing but still slight chance of R3 radio blackouts from X class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with a long duration M2.2 flare observed which peaked at 15/1149 UTC. A CME was associated with this flare and will be analysed when more imagery becomes available. Due to the source location an Earth-directed component is not expected. There are signs of increasing activity as potential regions from the far side approach, and this appears to be the source. There are three sunspot regions on the visible disc, with the most developmental AR2990 Dso/Beta. Two uni-bipolar regions AR2989 Hsx/Alpha and AR2991 Hsx/alpha have remained stable. No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was observed to be slightly elevated to elevated starting the period around 480 km/s but ending near 580 km/s, likely due to the connection with a High Speed Stream from positive coronal hole 74. The density was average to above average, peaking at 30 ppcc, ending the period just above 10 ppcc. The interplanetary magnetic field (IMF) strength Bt, was observed to be at strong levels at first following the CME arrival on the 14th, around 20 nT. During the period the IMF eased back to weak values below 8 nT. The north-south component Bz fluctuated between -12 nT and +13 nT, though has settled into weak positive values. The phi angle has fluctuated but ended the period in a mostly positive (away from the sun) orientation. This resulted in a G1/Minor Storm interval observed 15/0000-0300 UTC. After this time mainly Unsettled to Active levels have been observed.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured at GOES-16 at GEO was at background levels. The high energy electron flux (greater than 2 MeV) was normal background to Moderate, peaking at 641 pfu at 15/1600 UTC. The associated 24 hour electron fluence has been below the Active threshold throughout, but now with a rising trend in recent hours, with observed fluence of 2.13e7 integrated pfu by GOES-16 at 15/2359 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate. The long duration M flare on the 15th was from a region off the east limb which is expected to appear on day 1 (16th). It may be, or is close to, Ex 2975 which was active on the last rotation. The three sunspot regions on the disc are small, and only showing limited growth, however the activity from the far-side is approaching the eastern limb with further M-class flares increasingly likely to affect Earth.

Solar Wind / Geomagnetic Activity: Earth is now exiting the magnetic cloud from the CME which left the Sun on the 11th, however, Earth appears to have connected with the High Speed Stream from CH74. Solar winds are forecast to decline at first on day 1 (16th) before a further enhancement from the arrival of the fast wind of CH75/+ is forecast on day 2 or early on day 3 (17th-18th), although this is low confidence. No further CME arrivals are expected. Geomagnetic activity is forecast to be mostly Unsettled to Active with a slight chance of further G1/Minor Storms at first and again on arrival of the faster solar winds, most likely day 2 (17th) or early day 3 (18th). By day 4 (19th) a return to mainly Quiet conditions is likely.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to persist at background levels. High energy electron flux (greater than 2 MeV) is likely to reach Moderate levels, perhaps peaking at High near the diurnal maximum each day, although a temporary drop-out is likely on arrival of the Coronal Hole HSS early on Day 2 (17 April). The associated 24 hour electron fluence starting below the Active (1e8 integrated pfu) threshold with a chance of approaching the active threshold by day 3 (18 April).

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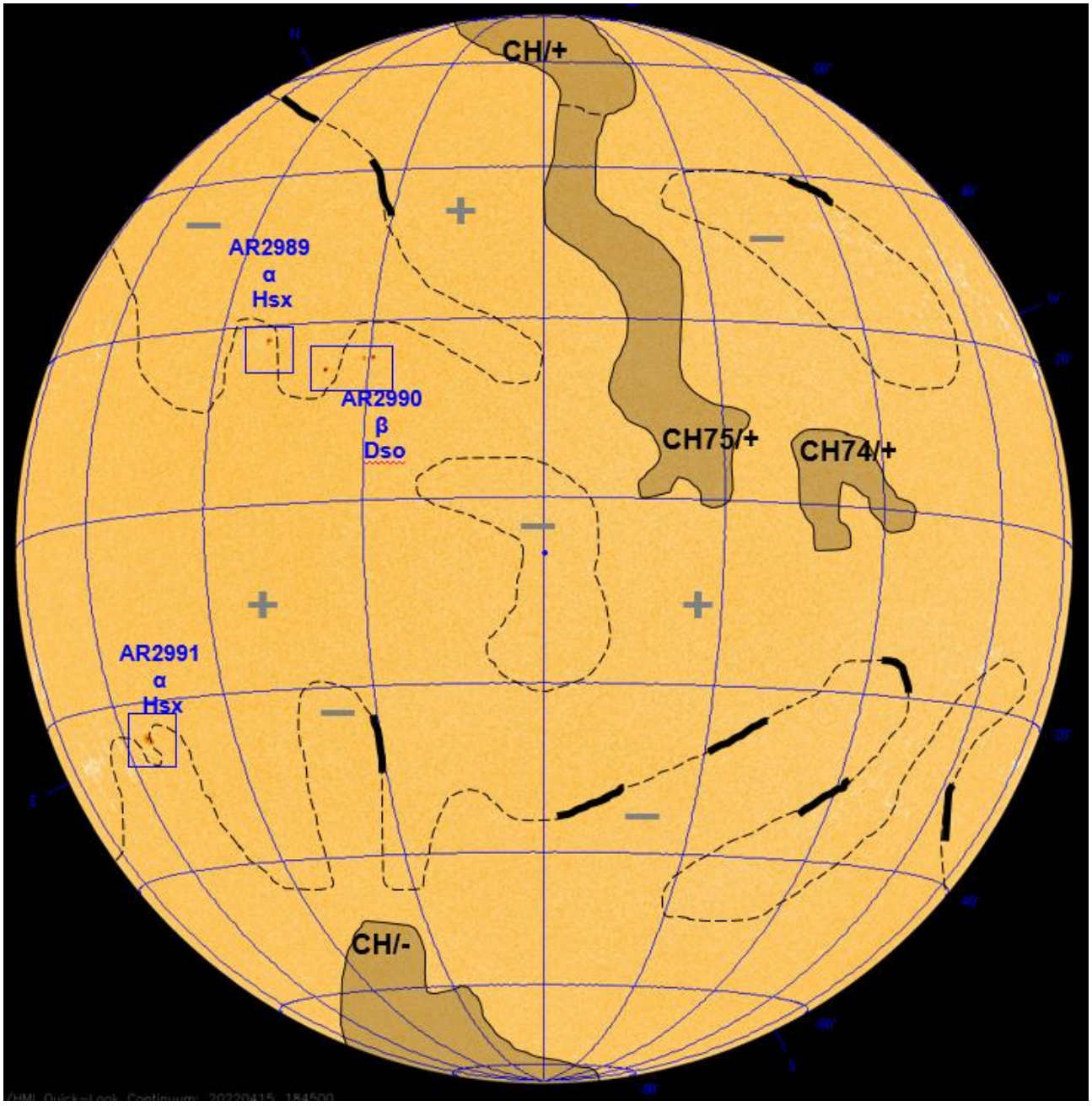
Figure 1. Solar Analysis Valid 15/1900UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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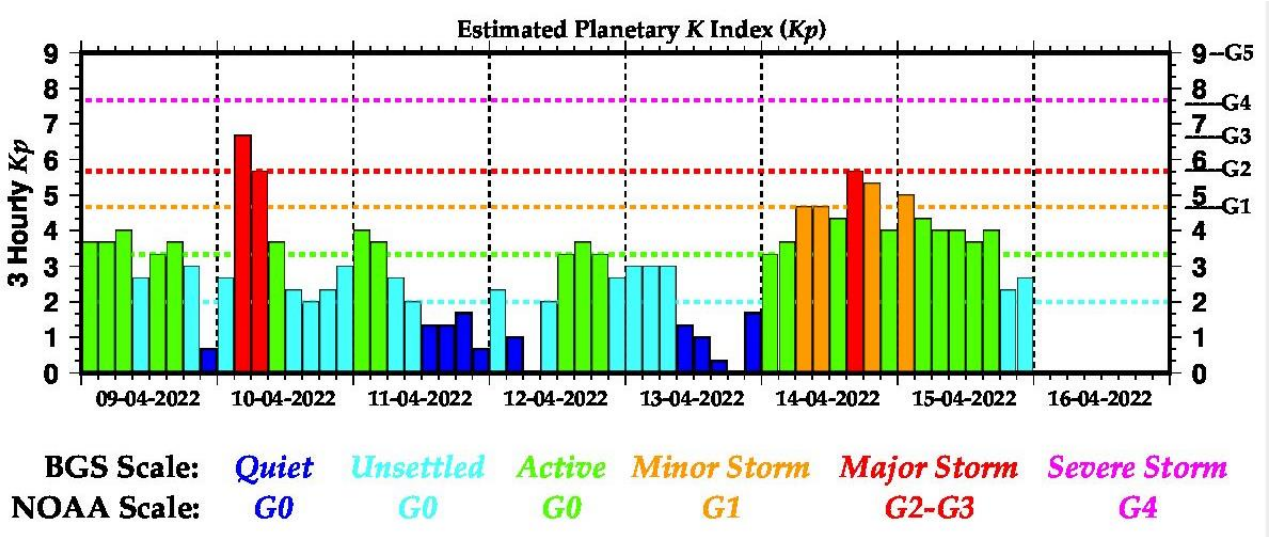
Geomagnetic Storms:

Earth is now exiting the magnetic cloud from the CME which left the Sun on the 11th, however, Earth appears to have connected with the High Speed Stream from CH74. This has resulted in elevated solar wind speeds around 580 km/s. Solar winds are forecast to decline at first on day 1 (16th) before a further enhancement from the arrival of the fast wind of CH75/+ is forecast on day 2 or early on day 3 (17th-18th). The timing and strength of this feature is low confidence, with a lack of a clear signal from STEREO A Mag and PLASTIC data, and also being new to this rotation, limiting the value of persistence. Furthermore, this is a positive coronal hole which is unfavoured for connection during spring (Russel-McPherron effect).
Any enhanced solar winds are expected to gradually ease later day 3 into day 4 (17th-18th). No further CME arrivals are expected. Geomagnetic activity is forecast to be mostly Unsettled to Active with a slight chance of further G1/Minor Storms at first and again on arrival of the faster solar winds, most likely day 2 (17th) or early day 3 (18th). By day 4 (19th) a return to mainly Quiet conditions is likely.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	20	20	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections- Nil

Figure 2: Geomagnetic activity now easing back following the CME arrival on the 14th.



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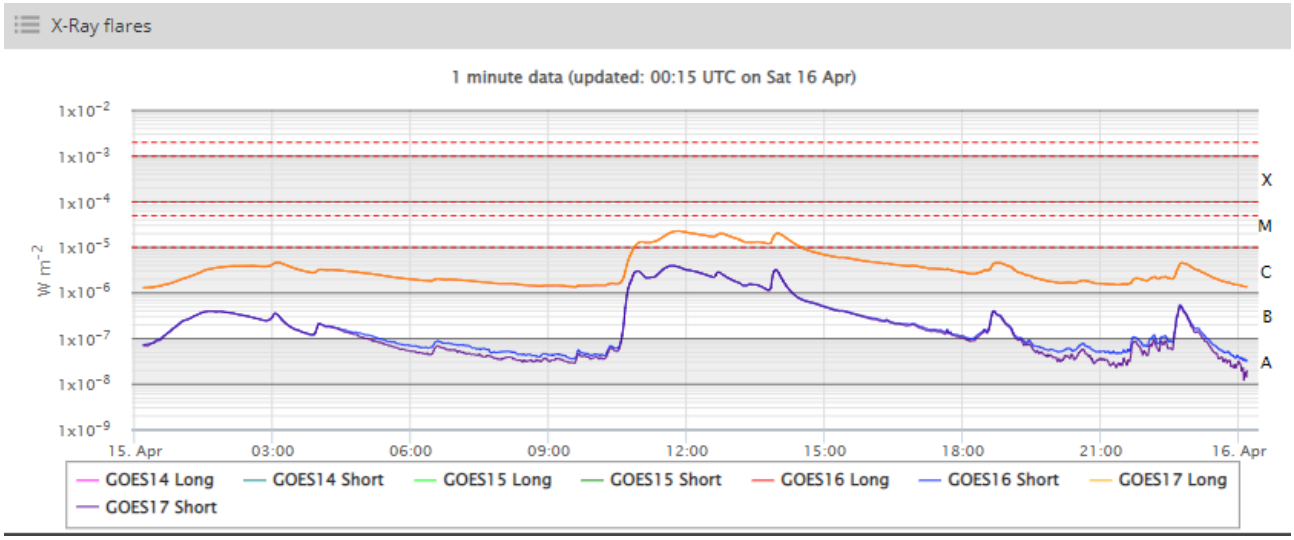
Radio Blackouts - X-Ray Flares:
Solar activity is expected to be Low to Moderate. The long duration M flare on the 15th was from a region off the east limb which is expected to appear late on day 1 (16th). It may be, or is close to, Ex 2975 which was active on the last rotation producing 40 C class flares, 7 M class flares and one X flare.

There are three sunspot regions on the disc. Whilst these are all small, and relatively simple regions some slight growth in the intermediate spots has been evident in AR2990 Dso/Beta, AR2989 Hsx/alpha in the northeast and AR2991 Hsx/alpha in the southeast, both appear to be simple and stable.
The far-side remains active with recent CMEs observed, and a notable signature on far-sided products, including helioseismographs and the GONG far-side magnetograph. This corresponds to the area around Ex-AR2975 which has been traversing across the far-side, and is due back onto the east limb on the Earth-side late on day 1 (16th), and matches to a bright area of flux on visible on the STEREO A EUVI-imagery. These far-side regions, alongside development on the near-side have led to background flux levels rising. Low to Moderate solar activity is therefore likely to continue this forecast period and an increase in M-class flares likely through the coming days as far-side regions approach the east limb, and this is reflected in the probabilities given in the table above.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	2	5	10	10

Figure 3: Unusually long duration M class flare with three peaks from a region not yet visible on the disk.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background and in the absence of complex sunspots on the Earth-facing disc is expected to remain at this level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

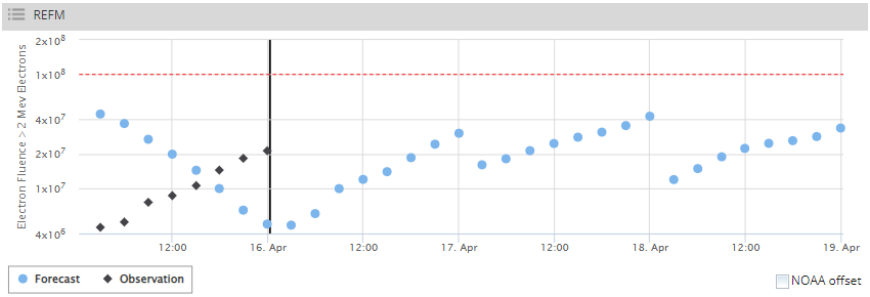
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 at GEO temporarily dropped out due to recent CME arrival, however the slight elevated to elevated solar wind environment has increased activity once more in the Van Allen belts resulting in the observed flux at GEO to rise to Moderate. There is a potential for it peaking at High levels during the diurnal maximum through the next 4 days. Any significant geomagnetic response due to CH influences may force a drop out in values but this may only be brief because a notable flux enhancement from this feature is currently considered unlikely, due to its unfavoured polarity, limited expected geomagnetic response, and the features relative immaturity with being new for this solar rotation.

The associated 24 hour electron fluence is likely to remain below the Active threshold throughout, but with a chance of approaching the active threshold by day 3 (18th). REFM is not giving good guidance at this stage and activity is likely to be higher at times than indicated.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	10	20	40
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: REFM not providing good guidance at the moment though is keeping integrated fluence levels below Active.



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